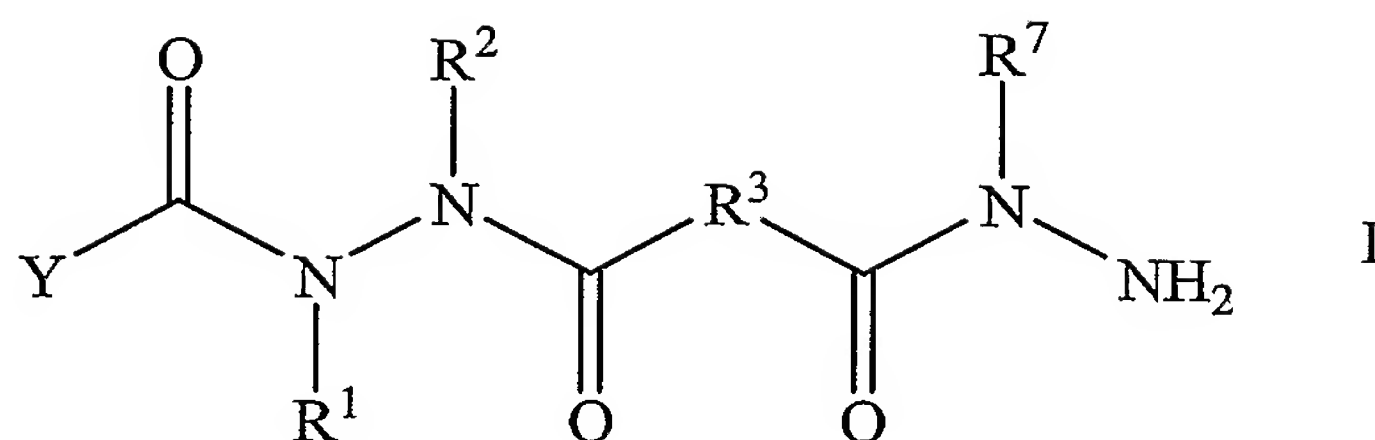


What is claimed:

1. A modified-glycosaminoglycan, wherein the modified-glycosaminoglycan comprises a glycosaminoglycan comprising at least one hydroxyl group chemically substituted with a hydrazide-reactive group or an aminooxy-reactive group.
5
2. The modified-glycosaminoglycan of claim 1, wherein the glycosaminoglycan comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, or heparan sulfate.
3. The modified-glycosaminoglycan of claim 1, wherein the glycosaminoglycan comprises hyaluronan.
10
4. The modified-glycosaminoglycan of claim 3, wherein at least one primary C-6 hydroxyl group of a N-acetyl-glucosamine residue is substituted with the hydrazide-reactive group or the aminooxy-reactive group.
5. The modified-glycosaminoglycan of claim 4, wherein at least one secondary hydroxyl group is substituted with the hydrazide-reactive group or the aminooxy-reactive group.
15
6. The modified-glycosaminoglycan of claim 4, wherein from one primary C-6 hydroxyl group of the N-acetyl-glucosamine residue to 100 % of the primary C-6 hydroxyl groups of the N-acetyl-glucosamine residue are substituted with the hydrazide-reactive group or the aminooxy-reactive group.
20
7. The modified-glycosaminoglycan of claim 1, wherein the hydroxyl group comprises a primary C-6 hydroxyl group of the non-uronic acid sugar component of the repeating disaccharide of the glycosaminoglycan.
8. The modified-glycosaminoglycan of claim 1, wherein the hydrazide-reactive group or the aminooxy-reactive group comprises a carboxylic group or the salt or ester thereof.
25

9. The modified-glycosaminoglycan of claim 1, wherein the hydrazide-reactive group or the aminooxy-reactive group comprises the formula $-L-CO_2H$ or the salt or ester thereof, wherein L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.
10. The modified-glycosaminoglycan of claim 9, wherein L comprises a polyalkylene group having the formula $(CH_2)_n$, wherein n is from 1 to 10.
11. The modified-glycosaminoglycan of claim 1, wherein the hydrazide-reactive group or the aminooxy-reactive group comprises $-CH_2CO_2H$ or the salt or ester thereof.
12. The modified-glycosaminoglycan of claim 1, wherein the modified-glycosaminoglycan comprises hyaluronan with at least one primary C-6 hydroxyl group of the N-acetyl-glucosamine residue substituted with $-CH_2CO_2H$ or the salt or ester thereof.
13. The modified-glycosaminoglycan of claim 12, wherein at least one secondary hydroxyl group is substituted with the hydrazide-reactive group or the aminooxy-reactive group.
14. A method for making a modified-glycosaminoglycan, comprising (a) reacting a glycosaminoglycan with a base to produce deprotonated-glycosaminoglycan, and (b) reacting the deprotonated-glycosaminoglycan with a compound comprising at least one hydrazide-reactive group or aminooxy-reactive group.
15. The method of claim 14, wherein the base comprises a hydroxide, an alkoxide, a carbonate, a phosphate, or an amine.
16. The method of claim 14, wherein the compound is capable of reacting with an alkoxide.

17. The method of claim 14, wherein the compound comprises a leaving group.
18. The method of claim 14, wherein the compound comprises LG-L-G, wherein LG comprises a leaving group; L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof; and G comprises a hydrazide-reactive group or an aminooxy-reactive group.
19. The method of claim 18, wherein LG comprises a halogen.
20. The method of claim 18, wherein L comprises a polyalkylene group having the formula $(CH_2)_n$, wherein n is from 1 to 10.
21. The method of claim 20, wherein n is 1.
22. The method of claim 14, wherein G comprises a CO_2H group or the salt or ester thereof.
23. The method of claim 18, wherein the glycosaminoglycan comprises hyaluronan and the compound comprises $LGCH_2CO_2H$ or the salt or ester thereof, wherein LG comprises a halogen or OR^{21} , wherein R^{21} comprises mesylate, tosylate, or triflate.
24. A modified-glycosaminoglycan made by the process of claims 14-23.
25. A compound comprising the modified-glycosaminoglycan of claims 1-13 and 24, wherein the modified-glycosaminoglycan comprises at least one hydrazide group, at least one aminooxy group, or at least one hydrazide group and at least one aminooxy group.
26. The compound of claim 25, wherein the compound comprises two or more hydrazide groups.
27. The compound of claim 25, wherein the compound comprises at least one unit comprising the formula I



wherein

Y comprises a residue of the modified-glycosaminoglycan of claims 1-13 and 24; and

5 R^1 , R^2 , R^3 , and R^7 comprise, independently, hydrogen, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, or a polyether group, wherein R^3 is not hydrogen.

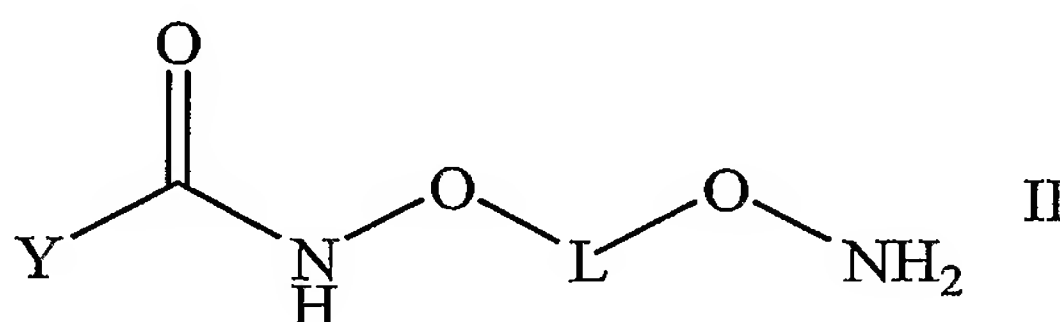
28. The compound of claim 27, wherein R^1 , R^2 , and R^7 are hydrogen.

10 29. The compound of claim 27, wherein R^3 comprises an alkyl group.

30. The compound of claim 27, wherein R^3 comprises $(CH_2)_n$, wherein n is from 1 to 20.

31. The compound of claim 30, wherein n is from 2 to 4.

15 32. The compound of claim 25, wherein the compound comprises at least one unit comprising the formula II



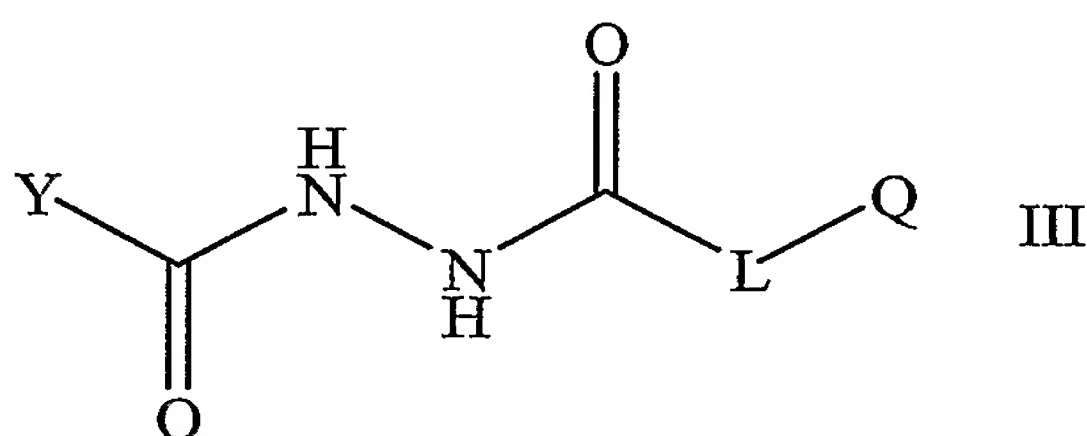
wherein

Y comprises a residue of the modified-glycosaminoglycan of claims 1-13 and 24; and

20 L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene

group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

33. The compound of claim 25, wherein the compound comprises at least one fragment comprising the formula III



wherein

Y comprises a residue of the modified-glycosaminoglycan of claims 1- 13 and 24;

Q comprises a residue of a bioactive agent, SH group or a thiol-reactive electrophilic functional group; and

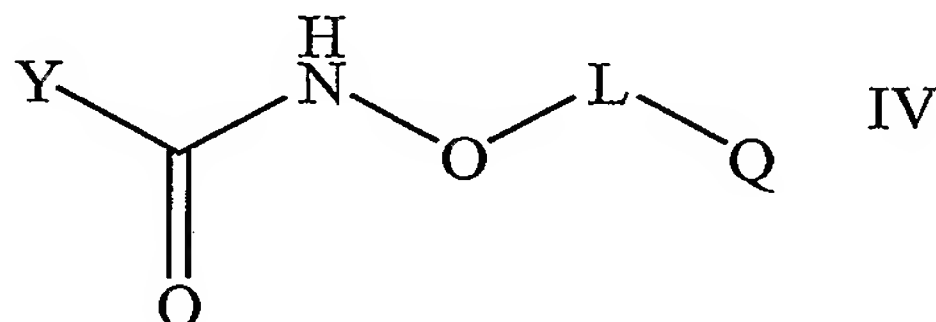
L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

34. The compound of claim 33, wherein when Q is a thiol-reactive electrophilic functional group, the thiol-reactive electrophilic functional group comprises an electron-deficient vinyl group.

35. The compound of claim 34, wherein the electron-deficient vinyl group comprises a nitro group, a cyano group, an ester group, an aldehyde group, a keto group, a sulfone group, or an amide group.

36. The compound of claim 33, wherein when Q comprises a thiol-reactive electrophilic functional group, the thiol-reactive electrophilic functional group comprises an acrylate group.

37. The compound of claim 33, wherein L comprises CH₂, CH₂CH₂, or CH₂CH₂CH₂ and Q comprises a SH group.
38. The compound of claim 25, wherein the compound comprises at least one fragment comprising the formula IV



5

wherein

Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24;

10

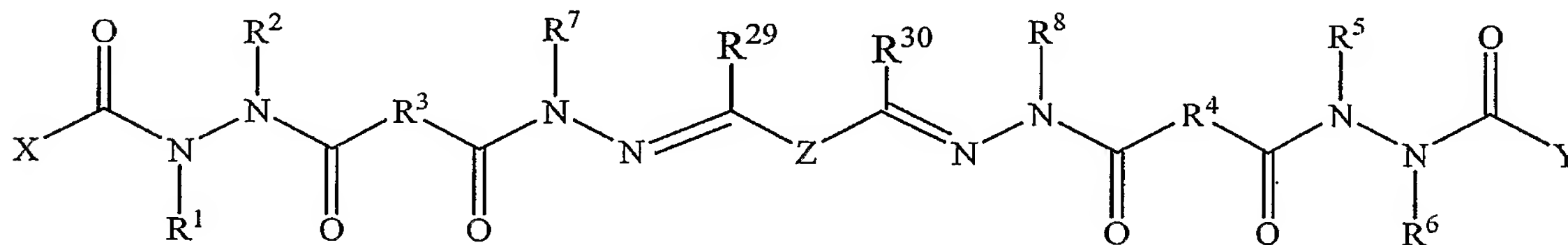
Q comprises a residue of a bioactive agent, an aminooxy group, SH group or a thiol-reactive electrophilic functional group; and

15

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

39. The compound of claim 38, wherein when Q comprises a thiol-reactive electrophilic functional group, the thiol-reactive electrophilic functional group comprises an electron-deficient vinyl group.
40. The compound of claim 39, wherein the electron-deficient vinyl group comprises a nitro group, a cyano group, an ester group, an aldehyde group, a keto group, a sulfone group, or an amide group.
41. The compound of claim 38, wherein when Q comprises a thiol-reactive electrophilic functional group, the thiol-reactive electrophilic functional group comprises an acrylate group.
42. The compound of claim 38, wherein Q comprises a SH group.

43. The compound of claim 38, wherein L comprises a polyalkylene group comprising the formula $(CH_2)_n$, wherein n is from 1 to 10.
44. The compound of claim 43, wherein n is from 1 to 4.
45. A method for making a compound comprising reacting the modified-glycosaminoglycan of claims 1- 13 and 24 with a hydrazide compound.
46. A method for making a compound comprising reacting the modified-glycosaminoglycan of claims 1-13 and 24 with an aminooxy ether compound.
47. The compounds produced by the methods of claims 45 or 46.
48. A compound comprising at least one fragment comprising the formula V

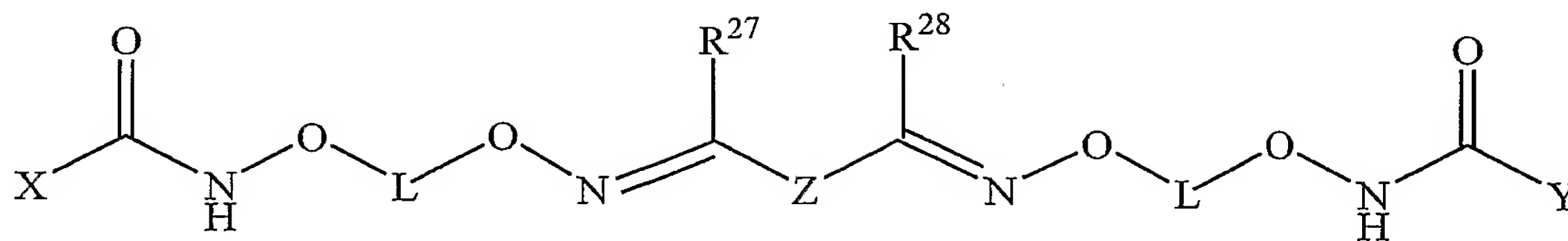


V

wherein

- Y comprises a residue of the modified-glycosaminoglycan of claims 1-13 and 24;
- X comprises a residue of a macromolecule;
- R^{29} and R^{30} comprise, independently, hydrogen or lower alkyl; and
- Z, R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , R^7 , and R^8 comprise, independently, hydrogen, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof, wherein Z, R^3 , and R^4 are not hydrogen.

49. The compound of claim 48, wherein the macromolecule comprises an oligonucleotide, a nucleic acid or a metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-acceptable compound.
- 5 50. The compound of claim 48, wherein the macromolecule comprises a polysaccharide, a protein, or a synthetic polymer.
51. The compound of claim 50, wherein the macromolecule comprises a polysaccharide, wherein the polysaccharide comprises a sulfated-glycosaminoglycan.
- 10 52. The compound of claim 48, wherein the macromolecule comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose.
53. The compound of claim 48, wherein the macromolecule comprises hyaluronan.
- 15 54. The compound of claim 48, wherein Z comprises a polyether.
55. The compound of claim 48, wherein R^1 , R^2 , R^5 , R^6 , R^7 , and R^8 are hydrogen.
56. The compound of claim 48, wherein R^3 and R^4 comprise an alkyl group.
57. The compound of claim 48, wherein R^3 and R^4 comprise $(CH_2)_n$, wherein n is from 1 to 20.
- 20 58. The compound of claim 57, wherein n is from 2 to 4.
59. The compound of claim 48, wherein the compound comprises from 10 to 10,000 units having the formula V.
60. A compound comprising at least one fragment comprising the formula VI



VI

wherein

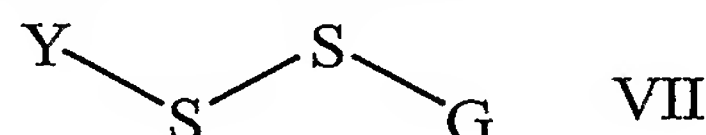
X and Y comprises a residue of a macromolecule;

R^{27} and R^{28} comprise, independently, hydrogen or lower alkyl; and

5 L and Z comprise, independently, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

10 61. A method for producing a compound comprising reacting (1) the compound of claims 25-44 or 47 with (2) a polycarbonyl crosslinker.

62. A compound comprising at least one fragment comprising the formula VII



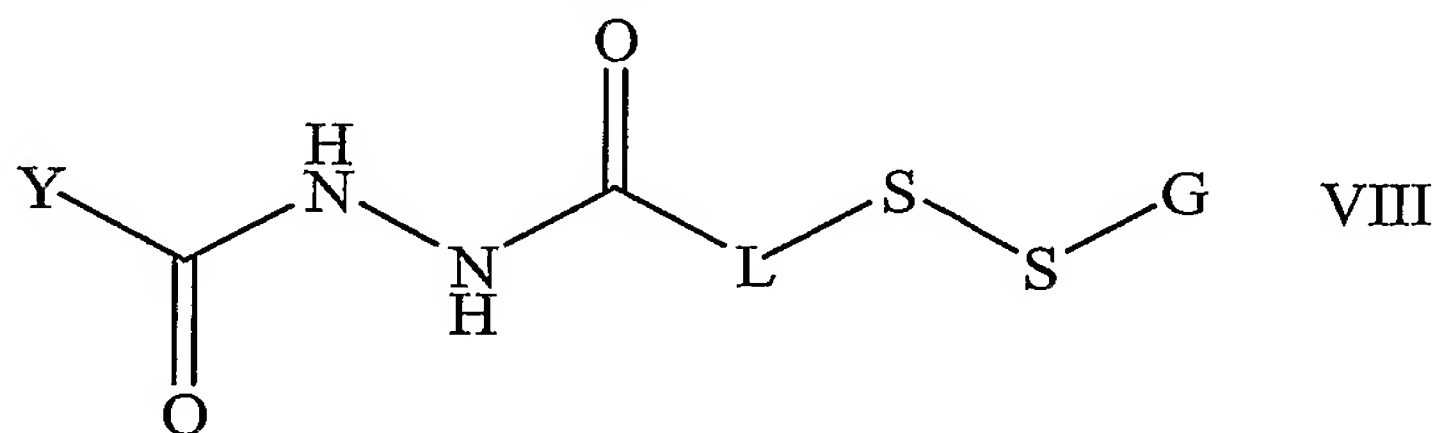
VII

wherein

15 Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24, and

G comprises a residue of a thiolated compound.

63. A compound comprising at least one fragment comprising the formula VIII



VIII

wherein

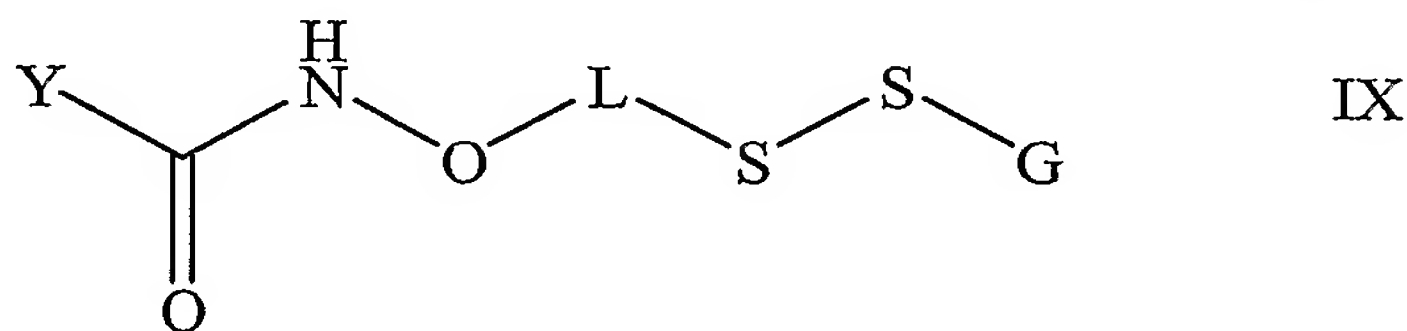
Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24;

5

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof; and

G comprises a residue of a thiolated compound.

- 10 64. The compound of claim 63, wherein L comprises CH₂, CH₂CH₂, or CH₂CH₂CH₂.
65. The compound of claim 63, wherein G comprises a polysaccharide residue.
66. The compound of claim 63, wherein G comprises a sulfated-glycosaminoglycan residue.
- 15 67. The compound of claim 63, wherein G comprises a residue of chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose, or hyaluronan.
68. A compound comprising at least one fragment comprising the formula IX



20

wherein

Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24;

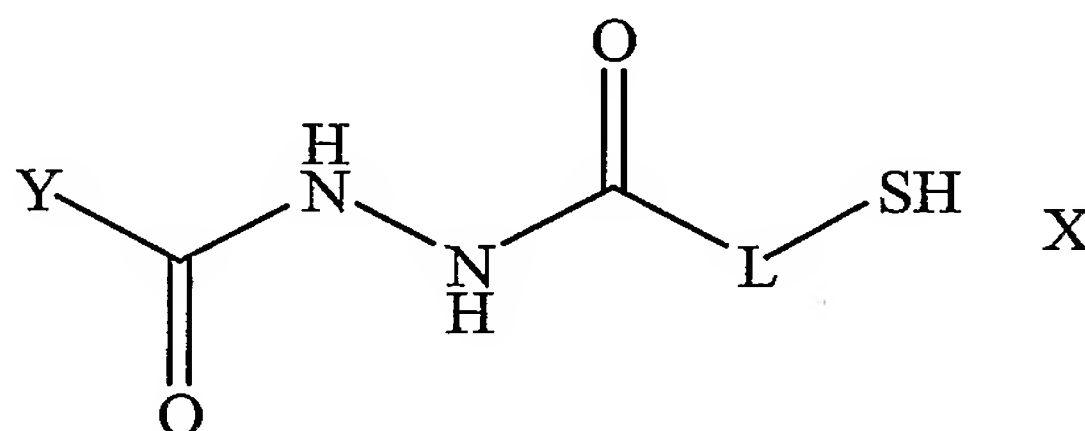
25

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an

aryl group, a polyester, a polythioether group, a polysaccharyl group,
or a combination thereof; and

G comprises a residue of a thiolated compound.

69. A method for coupling two or more thiolated compounds, comprising
5 reacting a first thiolated compound having the formula X



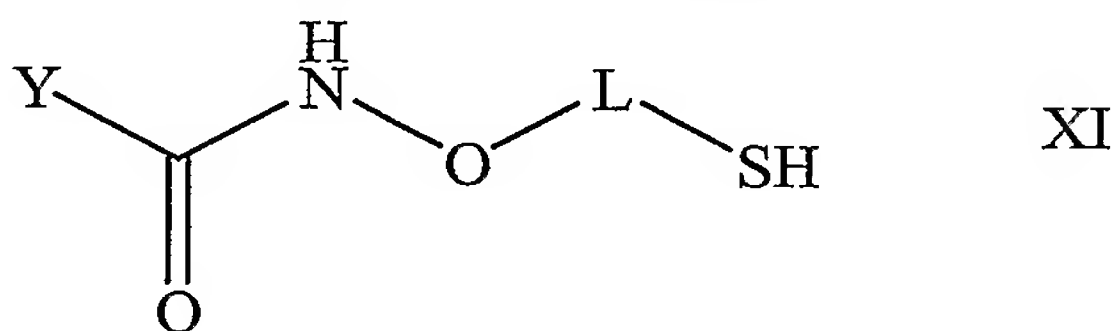
wherein

Y comprises a residue of a modified-glycosaminoglycan of claims 1-
13 and 24, and

- 10 L comprises a substituted or unsubstituted hydrocarbyl group, a
substituted or unsubstituted heterohydrocarbyl group, a polyalkylene
group, a polyether group, a polyamide group, a polyimino group, an
aryl group, a polyester, a polythioether group, a polysaccharyl group,
or a combination thereof,

- 15 with a second thiolated compound having at least one SH group in the
presence of an oxidant,
wherein the first thiolated compound and second thiolated compound are the
same or different compounds.

70. A method for coupling two or more thiolated compounds, comprising
20 reacting a first thiolated compound having the formula XI



wherein

Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24, and

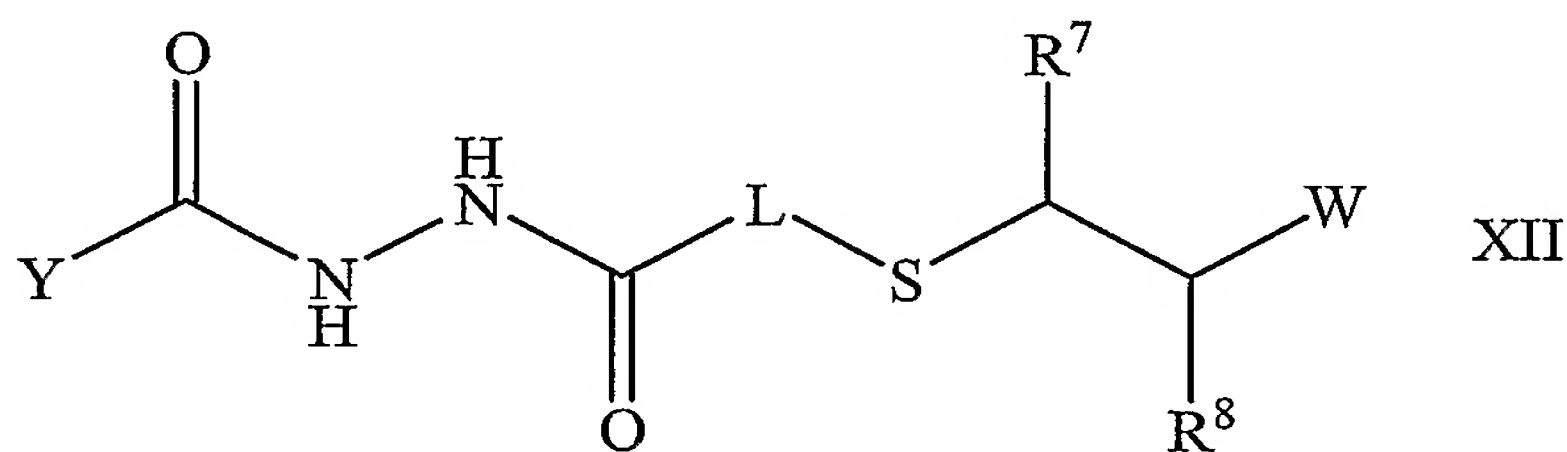
L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof,

with a second thiolated compound having at least one SH group in the presence of an oxidant,

wherein the first thiolated compound and second thiolated compound are the same or different compounds.

71. The compounds produced by the methods of claims 70 or 71.

72. A compound comprising at least one fragment comprising the formula XII



wherein

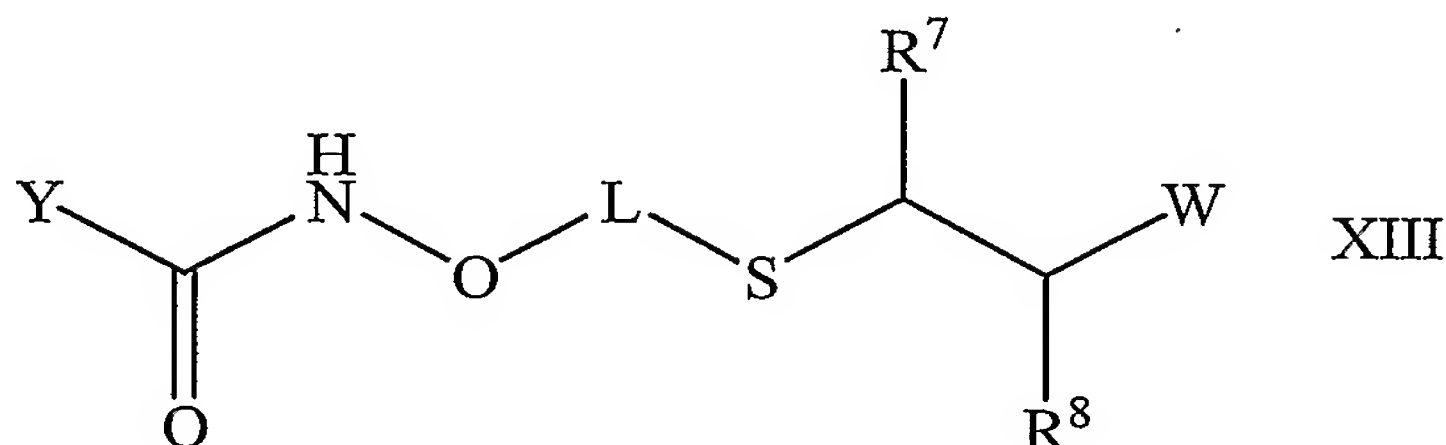
R^7 and R^8 comprise, independently, hydrogen or lower alkyl;

W comprises an electron-withdrawing group;

Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24; and

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

73. A compound comprising at least one fragment comprising the formula XIII



wherein

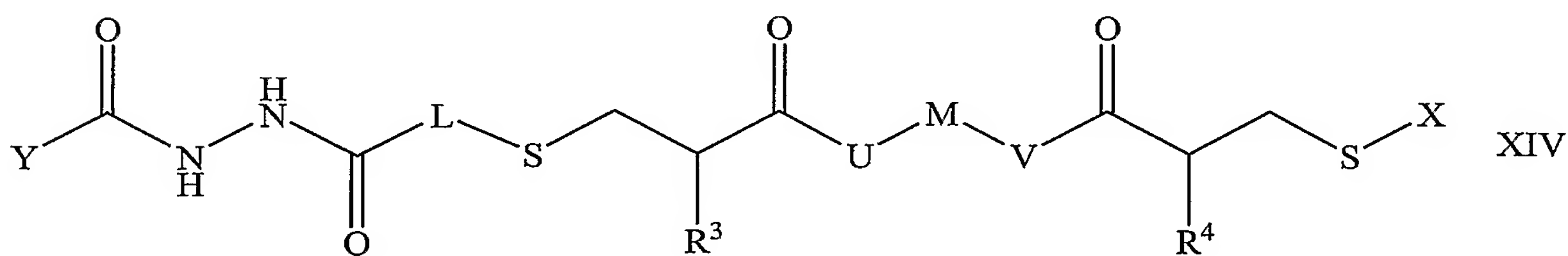
R^7 and R^8 comprise, independently, hydrogen or lower alkyl;

5 W comprises an electron-withdrawing group;

Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24; and

10 L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

74. A compound comprising at least one fragment comprising the formula XIV



15 wherein

R^3 and R^4 comprise, independently, hydrogen or lower alkyl;

U and V comprise, independently, O or NR^5 , wherein R^5 is, independently, hydrogen or lower alkyl;

20 Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24;

X comprises a residue of a macromolecule; and

L and M comprise, independently, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

5

75. The compound of claim 74, wherein Y is X'OCH₂-, wherein X' comprises a residue of a macromolecule.

10

76. The compound of claim 74, wherein X' comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, or pectin.

77. The compound of claim 74, wherein X' is hyaluronan.

78. The compound in any of claims 74-77, wherein R³ and R⁴ are hydrogen, U and V are oxygen, and M is a polyether group.

15

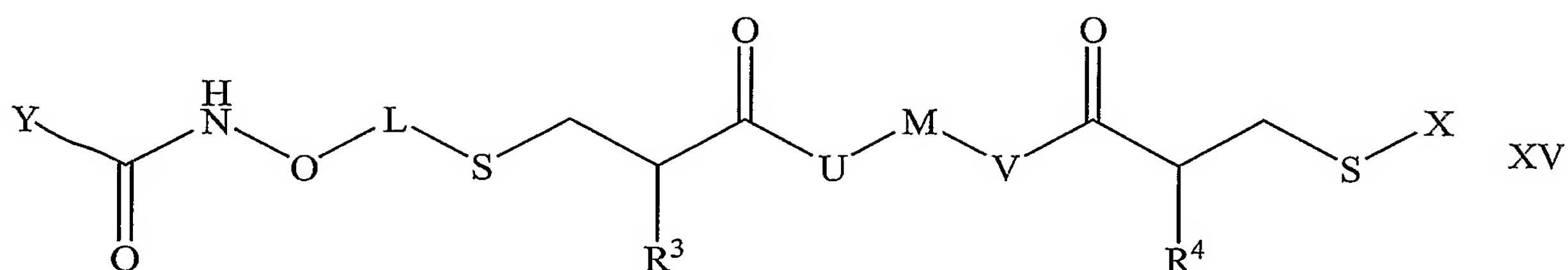
79. The compound in any of claims 74-77, wherein L is a CH₂CH₂ group.

80. The compound of claim 74, wherein Y is X'OCH₂-, wherein X' is hyaluronan, R³ and R⁴ are hydrogen, U and V are oxygen, M is a polyether group, L is a CH₂CH₂ group, and X is CH₂CH₂C(O)NHNHC(O)X'', where X'' is a residue of hyaluronan.

20

81. The compound of claim 74, wherein Y is X'OCH₂-, wherein X' is hyaluronan, R³ and R⁴ are hydrogen, U and V are oxygen, M is a polyether group, L is a CH₂CH₂ group, and X is CH₂CH₂C(O)NHNHC(O)X'', where X'' is a residue of gelatin.

82. A compound comprising at least one fragment comprising the formula XV



wherein

R^3 and R^4 comprise, independently, hydrogen or lower alkyl;

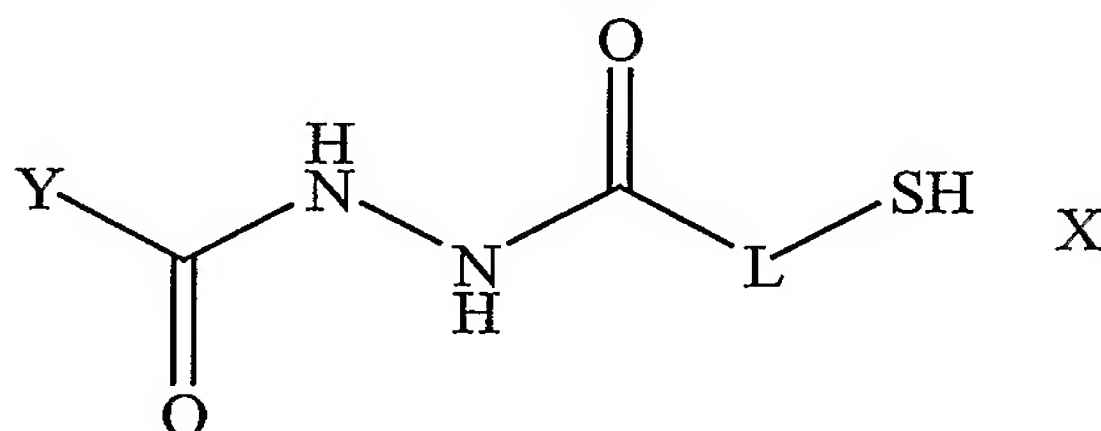
U and V comprise, independently, O or NR^5 , wherein R^5 is,
independently, hydrogen or lower alkyl;

Y comprises a residue of a modified-glycosaminoglycan of claims 1-
13 and 24;

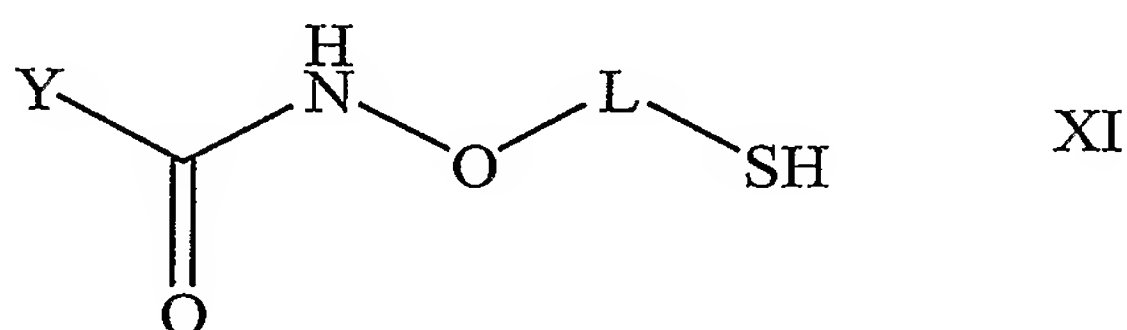
X comprises a residue of a macromolecule; and

L and M comprise, independently, a substituted or unsubstituted
hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl
group, a polyalkylene group, a polyether group, a polyamide group, a
polyimino group, an aryl group, a polyester, a polythioether group, a
polysaccharyl group, or a combination thereof.

83. A method for making a compound, comprising reacting a first thiolated
compound comprising at least one fragment having the formula X or XI



or



wherein

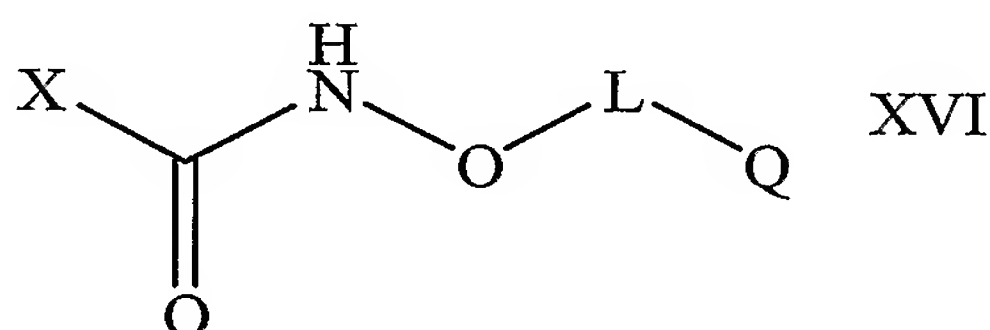
Y comprises a residue of a modified-glycosaminoglycan of claims 1-13 and 24, and

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof,

with at least one compound having at least one thiol-reactive electrophilic functional group.

84. A compound made by the method of claim 83.

85. A compound comprising at least one fragment comprising the formula XVI



wherein

X comprises a residue of a macromolecule;

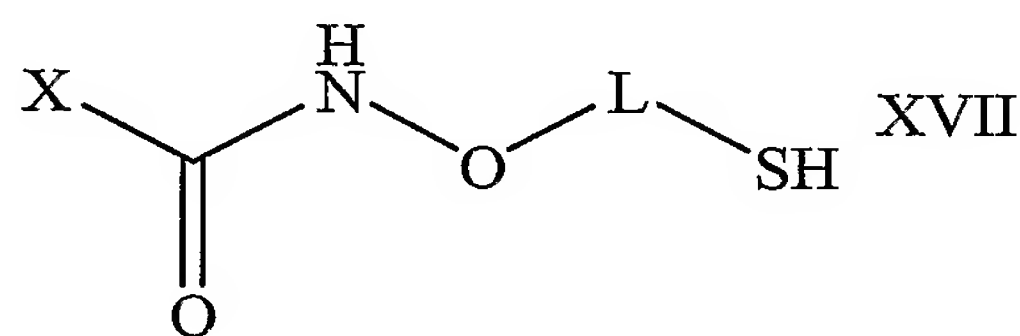
Q comprises a residue of a bioactive agent, an aminooxy group, a SH group, or a thiol-reactive electrophilic functional group; and

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

86. The compound of claim 85, wherein the macromolecule comprises an oligonucleotide, a nucleic acid or a metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-acceptable compound.

87. The compound of claim 85, wherein the macromolecule comprises a polysaccharide, a protein, or a synthetic polymer.
88. The compound of claim 85, wherein the macromolecule comprises a polysaccharide, wherein the polysaccharide comprises a sulfated-
5 glycosaminoglycan.
89. The compound of claim 85, wherein the macromolecule comprises a synthetic polymer, wherein the synthetic polymer comprises glucuronic acid, polyacrylic acid, polyaspartic acid, polytartaric acid, polyglutamic acid, or polyfumaric acid.
- 10 90. The compound of claim 85, wherein the macromolecule comprises a protein, wherein the protein comprises a naturally-occurring protein or a recombinant protein.
91. The compound of claim 85, wherein the macromolecule comprises a protein, wherein the protein comprises an extracellular matrix protein, a chemically-
15 modified extracellular matrix protein, or a partially hydrolyzed derivative of an extracellular matrix protein.
92. The compound of claim 85, wherein the macromolecule comprises a protein, wherein the protein comprises collagen, elastin, decorin, laminin, or fibronectin.
- 20 93. The compound of claim 85, wherein the macromolecule comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose.
94. The compound of claim 85, wherein the macromolecule comprises hyaluronan.
- 25 95. The compound of claim 85, wherein when Q comprises a thiol-reactive electrophilic functional group, the thiol-reactive electrophilic functional group comprises an electron-deficient vinyl group.

96. The compound of claim 95, wherein the electron-deficient vinyl group comprises a nitro group, a cyano group, an ester group, an aldehyde group, a keto group, a sulfone group, or an amide group.
97. The compound of claim 85, wherein when Q comprises a thiol-reactive electrophilic functional group, the thiol-reactive electrophilic functional group comprises an acrylate group.
98. The compound of claim 85, wherein when Q comprises a bioactive agent, the bioactive agent comprises a dye, a probe, a nucleic acid, an enzyme, an oligonucleotide, a label, a protein, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-acceptable compound.
99. A method for coupling two or more thiolated compounds, comprising reacting a first thiolated compound having the formula XVII



wherein

- X comprises a residue of a macromolecule, and
- L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof,

with a second thiolated compound having at least one SH group in the presence of an oxidant,

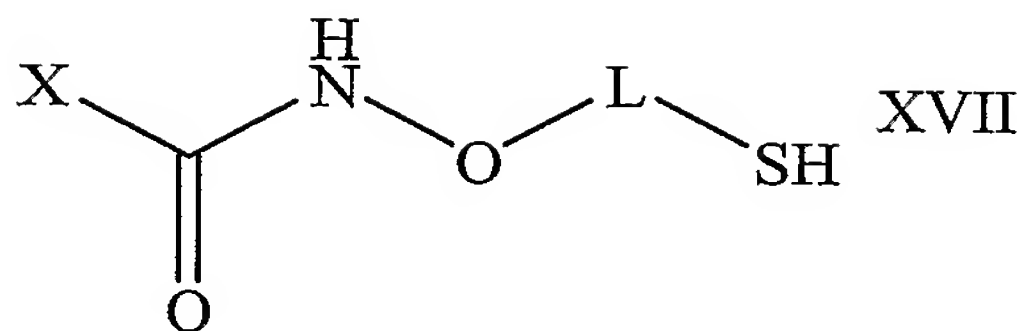
wherein the first thiolated compound and second thiolated compound are the same or different compounds.

100. The method of claim 99, wherein the macromolecule comprises an

oligonucleotide, a nucleic acid or a metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-acceptable compound.

101. The method of claim 99, wherein the macromolecule comprises a
5 polysaccharide, a protein, or a synthetic polymer.
102. The method of claim 101, wherein the macromolecule comprises a polysaccharide, wherein the polysaccharide comprises a sulfated-glycosaminoglycan.
103. The method of claim 99, wherein the macromolecule comprises chondroitin,
10 chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose.
104. The method of claim 99, wherein the macromolecule comprises hyaluronan.
105. The method of claim 99, wherein the second thiolated compound comprises a macromolecule comprising an oligonucleotide, a nucleic acid or a
15 metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-acceptable compound.
106. The method of claim 99, wherein the second thiolated compound comprises a polysaccharide having at least one SH group.
107. The method of claim 99, wherein the second thiolated compound comprises
20 a sulfated-glycosaminoglycan having at least one SH group.
108. The method of claim 99, wherein the second thiolated compound comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose, or hyaluronan, wherein each compound has at least one SH group.
- 25 109. The method of claim 99 wherein the second thiolated compound comprises a thiolated protein.
110. The method of claim 99, wherein the second thiolated compound has the

formula XVII



wherein

X comprises a residue of a macromolecule, and

5 L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof,

10 wherein the macromolecule residue in the first and second thiolated compounds is the same or different.

111. The method of claim 110, wherein the macromolecule comprises an oligonucleotide, a nucleic acid or a metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-
15 acceptable compound.

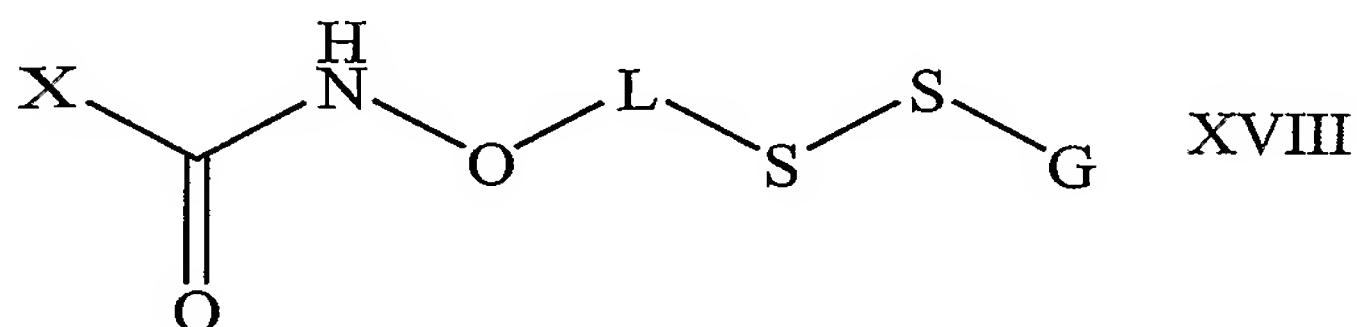
112. The method of claim 110, wherein the macromolecule comprises a polysaccharide, a protein, or a synthetic polymer.

113. The method of claim 99, wherein the first thiolated compound and the second thiolated compound are different.

20 114. The method of claim 99, wherein the oxidant comprises molecular iodine, hydrogen peroxide, an alkyl hydroperoxide, a peroxy acid, a dialkyl sulfoxide, a high valent metal, a metal oxide, or a halogen transfer agent.

115. The method of claim 99, wherein the oxidant comprises a gas comprising oxygen.

116. The method of claim 115, wherein the oxidant further comprises hydrogen peroxide.
117. A compound made by the method of claims 99-116.
118. A compound comprising at least one fragment comprising the formula XVIII



5

wherein

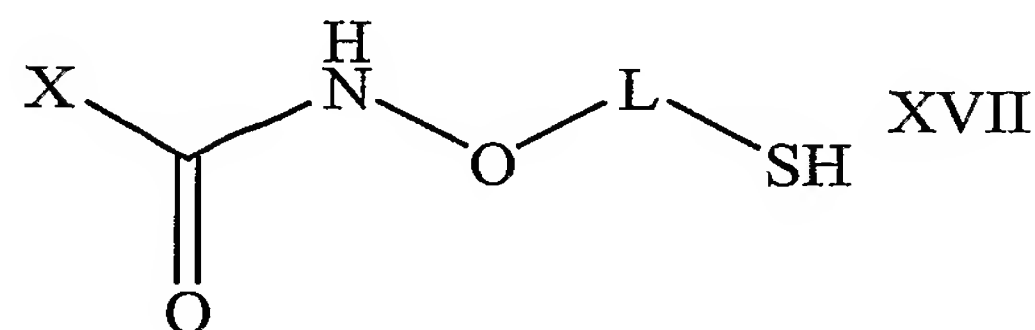
X comprises a residue of a macromolecule;

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof; and

G comprises a residue of a thiolated compound.

119. The compound of claim 118, wherein the macromolecule comprises an oligonucleotide, a nucleic acid or a metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, or a pharmaceutically-acceptable compound.
120. The compound of claim 118, wherein the macromolecule comprises a polysaccharide, a protein, or a synthetic polymer.
121. The compound of claim 118, wherein X comprises a residue of a sulfated-glycosaminoglycan.
122. The compound of claim 118, wherein X comprises a residue of chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose.

123. The compound of claim 118, wherein X is a residue of hyaluronan.
124. The compound of claim 118, wherein G comprises a residue of a thiolated polysaccharide.
125. The compound of claim 118, wherein G comprises a residue of a thiolated sulfated-glycosaminoglycan.
126. The compound of claim 118, wherein G comprises a residue of thiolated chondroitin sulfate, thiolated dermatan, thiolated heparan, thiolated heparin, thiolated dermatan sulfate, thiolated heparan sulfate, thiolated alginic acid, thiolated pectin, or thiolated carboxymethylcellulose.
127. The compound of claim 118, wherein G comprises a residue of thiolated hyaluronan.
128. A method for making a compound comprising reacting a first thiolated compound comprising the formula XVIII



wherein

X comprises a residue of a macromolecule, and

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

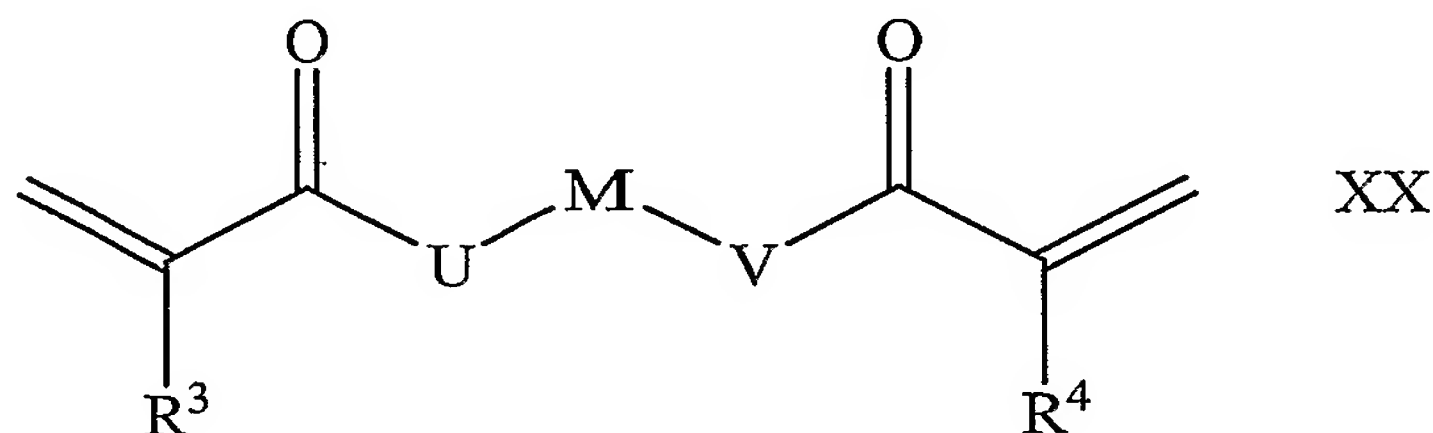
with at least one electrophilic compound having at least one thiol-reactive electrophilic functional group.

129. The method of claim 128, wherein the electrophilic compound has at least

two thiol-reactive electrophilic groups.

130. The method of claim 128, wherein the electrophilic compound has from 2 to 100 thiol-reactive electrophilic groups.
131. The method of claim 128, wherein the macromolecule comprises an
5 oligonucleotide, a nucleic acid or a metabolically stabilized analogue thereof, a polypeptide, a lipid, a glycoprotein, a glycolipid, a polysaccharide, a protein, a synthetic polymer, or a pharmaceutically-acceptable compound.
132. The method of claim 128, wherein the macromolecule comprises a
10 polysaccharide, wherein the polysaccharide comprises a sulfated-glycosaminoglycan.
133. The method of claim 128, wherein the macromolecule comprises a polysaccharide, wherein the polysaccharide comprises chondroitin sulfate, dermatan, heparan, heparin, dermatan sulfate, heparan sulfate, alginic acid, pectin, or carboxymethylcellulose.
- 15 134. The method of claim 128, wherein the macromolecule comprises a polysaccharide, wherein the polysaccharide comprises hyaluronan.
135. The method of claim 128, wherein the macromolecule comprises a protein,
20 wherein the protein comprises an extracellular matrix protein, a partially hydrolyzed extracellular matrix protein, or a chemically-modified extracellular matrix protein.
136. The method of claim 128, wherein the macromolecule comprises a protein,
wherein the protein comprises collagen, elastin, decorin, laminin, or fibronectin.
- 25 137. The method of claim 128, further comprising reacting a second thiolated compound with the first thiolated compound, the electrophilic compound, or a combination thereof, wherein the first and second compounds are the same or different.

138. The method of claim 128, wherein the thiol-reactive electrophilic functional group comprises an electron-deficient vinyl group.
139. The method of claim 138, wherein the electron-deficient vinyl group comprises a nitro group, a cyano group, an ester group, an aldehyde group, a keto group, a sulfone group, or an amide group.
140. The method of claim 128, wherein the electrophilic compound has two electron-deficient vinyl groups, wherein the two electron-deficient vinyl groups are the same.
141. The method of claim 128, wherein the electrophilic compound comprises a diacrylate, a dimethacrylate, a diacrylamide, a dimethacrylamide, or a combination thereof.
142. The method of claim 128, wherein the electrophilic compound comprises the formula XX



wherein

R^3 and R^4 comprise, independently, hydrogen or lower alkyl;

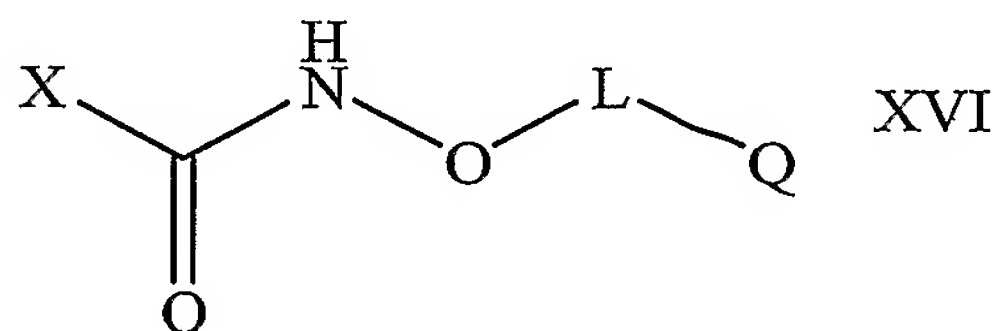
U and V comprise, independently, O or NR^5 , wherein R^5 is, independently, hydrogen or lower alkyl; and

M comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

143. The method of claim 142, wherein R^3 and R^4 are hydrogen, U and V are

oxygen, and M is a polyether group.

144. The method of claim 142, wherein R^3 and R^4 are hydrogen, U and V are NH, and M is a polyether group.
145. The method of claim 142, wherein R^3 and R^4 are methyl, U and V are oxygen, and M is a polyether group.
146. The method of claim 142, wherein R^3 and R^4 are methyl, U and V are NH, and M is a polyether group.
147. A method for making a compound comprising reacting a first electrophilic macromolecule comprising the formula XVI



wherein

X comprises a residue of the macromolecule;

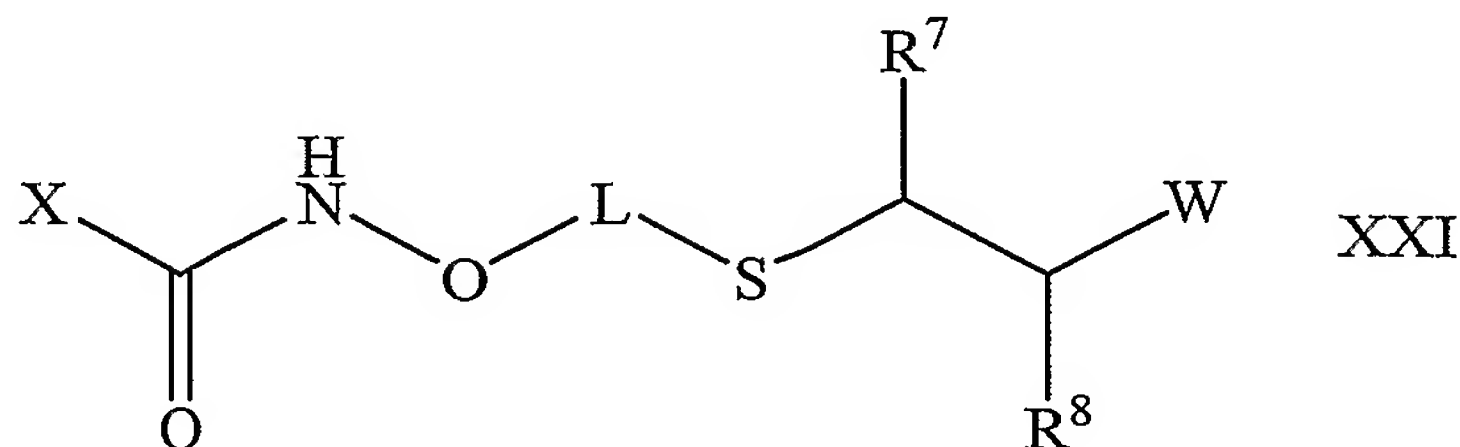
Q comprises a thiol-reactive electrophilic functional group; and

L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof,

with at least one compound having at least two thiol groups.

148. The method of claim 147, wherein X comprises a residue of a polysaccharide.
149. The method of claim 147, wherein X comprises a residue of hyaluronan.
150. The compound produced by the process of claims 127-149.

151. A compound comprising at least one fragment comprising the formula XXI



wherein

R^7 and R^8 comprise, independently, hydrogen or lower alkyl;

5 W comprises an electron-withdrawing group;

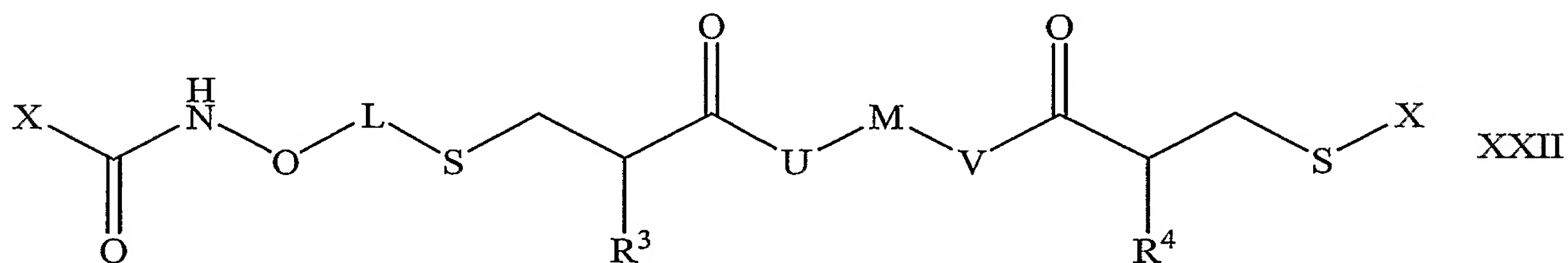
X comprises a residue of a macromolecule; and

10 L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

152. The compound of claim 151, wherein X comprises a polysaccharide residue.

153. The compound of claim 151, wherein W comprises $OC(O)R^{20}$, wherein R^{20} comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, or a combination thereof.

154. A compound comprising at least one fragment comprising the formula XXII



20 wherein

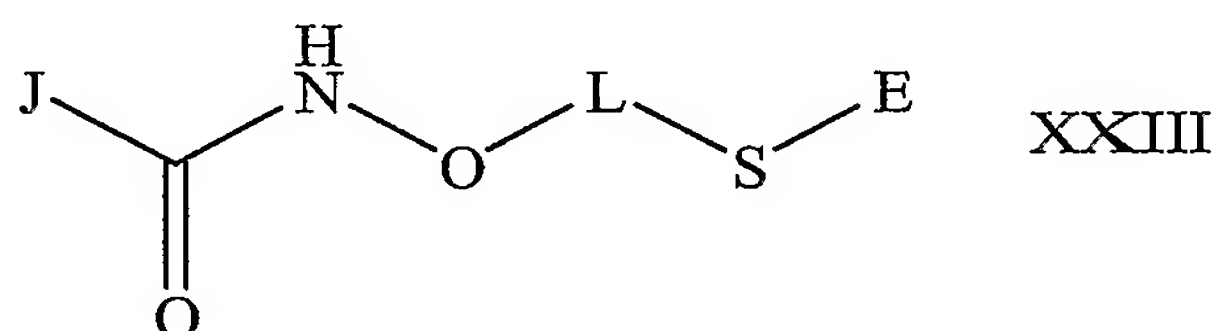
R^3 and R^4 comprise, independently, hydrogen or lower alkyl;

U and V comprise, independently, O or NR^5 , wherein R^5 is, independently, hydrogen or lower alkyl;

5 X comprises a residue of a macromolecule, wherein each residue is the same or different; and

L and M comprise, independently, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

155. A compound comprising the fragment comprising the formula XXIII



wherein

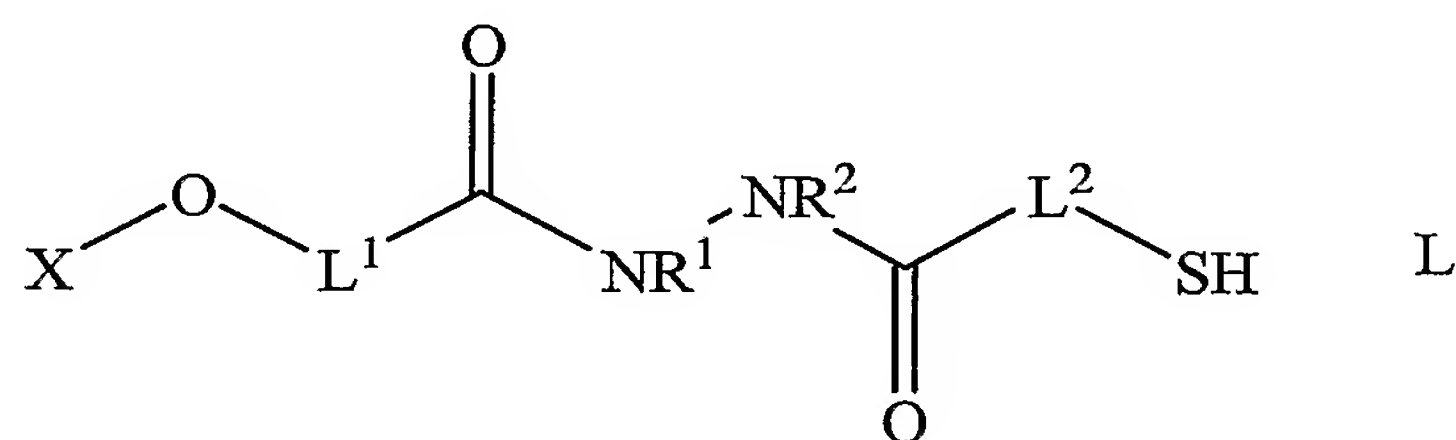
J comprises a protein residue;

15 L comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof; and

20 E comprises a fluorescent tag, a radiolabel, a targeting moiety, a lipid, a peptide, a radionuclide chelator with a radionuclide, a spin-label, a PEG camouflage, a metal surface, a glass surface, a plastic surface, or a combination thereof.

156. The compound of claim 155, wherein the protein comprises a naturally-
25 occurring protein or a recombinant protein.

157. The compound of claim 155, wherein the protein comprises an extracellular matrix protein, a partially hydrolyzed extracellular matrix protein, or a chemically-modified extracellular matrix protein.
158. The compound of claim 155, wherein the protein comprises collagen, elastin, decorin, laminin, or fibronectin.
159. A compound comprising at least one unit comprising the formula L



wherein

X comprises a residue of a macromolecule; and

R¹ and R² comprise, independently, hydrogen, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, or a polyether group;

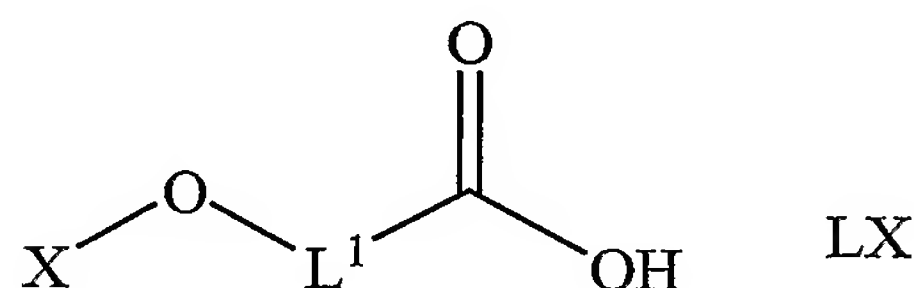
L¹ and L² comprise, independently, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a branched- or straight-chain alkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

160. The compound of claim 159, wherein R¹ and R² are hydrogen.

161. The compound of claim 159, wherein L¹ and L² are an alkylene group.

162. The compound of claim 159, wherein L¹ is CH₂ and L² is CH₂CH₂.

163. The compound of claim 159, wherein X comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, or pectin.
164. The compound of claim 159, wherein X is hyaluronan.
- 5 165. The compound of claim 159, wherein X is hyaluronan, R^1 and R^2 are hydrogen, L^1 is CH_2 , and L^2 is CH_2CH_2 .
166. A compound produced by the process comprising (1) reacting a compound comprising the formula LX

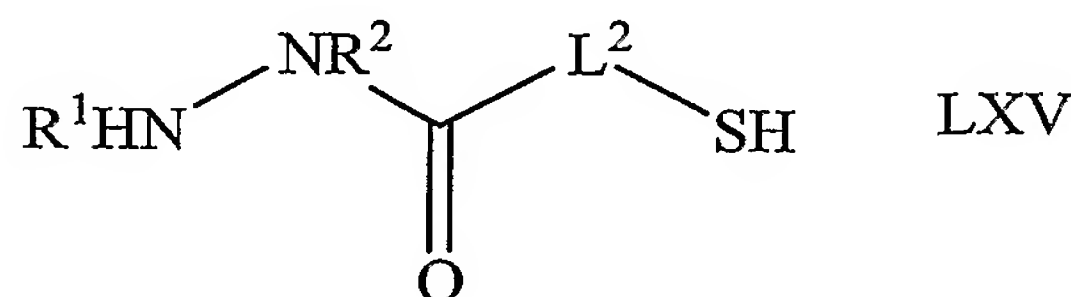


10 wherein

X comprises a residue of a macromolecule; and

15 L^1 comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a branched- or straight-chain alkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof,

with a compound comprising the formula LXV

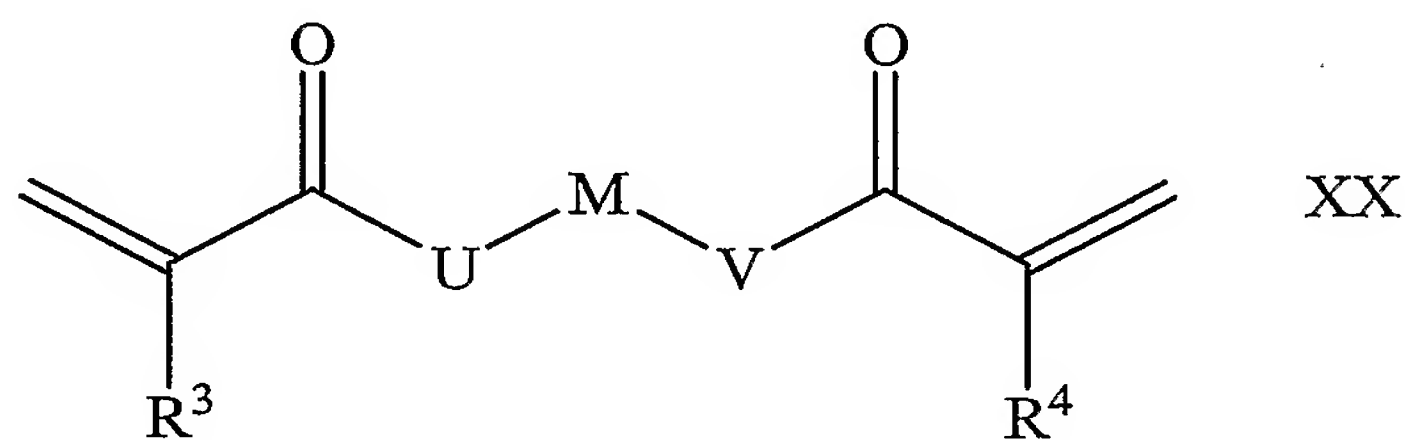


wherein

20 R^1 and R^2 comprise, independently, hydrogen, a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, or a polyether group, and

5 L² comprises a substituted or unsubstituted hydrocarbyl group, a substituted or unsubstituted heterohydrocarbyl group, a branched- or straight-chain alkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

167. The compound of claim 166, wherein R¹ and R² are hydrogen.
168. The compound of claim 166, wherein L¹ and L² are an alkylene group.
169. The compound of claim 166, wherein L¹ is CH₂ and L² is CH₂CH₂.
- 10 170. The compound of claim 166, wherein X comprises chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, or pectin.
171. The compound of claim 166, wherein X is hyaluronan.
172. The compound of claim 166, wherein X is hyaluronan, R¹ and R² are hydrogen, L¹ is CH₂, and L² is CH₂CH₂.
- 15 173. A compound produced by the process comprising reacting a thiolated compound in any of claims 159-172 with a compound comprising the formula XX



wherein

- 20 R³ and R⁴ comprise, independently, hydrogen or lower alkyl;
- U and V comprise, independently, O or NR⁵, wherein R⁵ is, independently, hydrogen or lower alkyl; and
- M comprises a substituted or unsubstituted hydrocarbyl group, a

substituted or unsubstituted heterohydrocarbyl group, a polyalkylene group, a polyether group, a polyamide group, a polyimino group, an aryl group, a polyester, a polythioether group, a polysaccharyl group, or a combination thereof.

- 5 174. The compound of claim 173, wherein R^3 and R^4 are hydrogen, U and V are oxygen, and M is a polyether group.
175. The compound of claim 173, wherein R^3 and R^4 are hydrogen, U and V are NH, and M is a polyether group.
176. The compound of claim 173, wherein R^3 and R^4 are methyl, U and V are oxygen, and M is a polyether group.
- 10 177. The compound of claim 173, wherein R^3 and R^4 are methyl, U and V are NH, and M is a polyether group.
178. The compound of claim 173, wherein the thiolated molecule comprises the compound of claim 165 or 172.
- 15 179. The compound of claim 173, wherein the thiolated molecule comprises the compound of claim 165 or 172 and the compound having the formula XX is poly(ethylene glycol) diacrylate.
180. The compound of claim 173, wherein the thiolated molecule comprises two or more different thiolated molecules.
- 20 181. The compound of claim 173, wherein the thiolated molecule comprises two thiolated molecules, wherein the first thiolated molecule is the compound of claim 165 or 172, the second thiolated molecule is a thiolated macromolecule, and the compound having the formula XX is poly(ethylene glycol) diacrylate.
- 25 182. The compound of claim 173, wherein the second thiolated molecule is thiolated chondroitin sulfate, thiolated dermatan, thiolated heparan, thiolated heparin, thiolated dermatan sulfate, thiolated heparan sulfate, thiolated

alginic acid, or thiolated pectin.

183. The compound of claim 173, wherein the second thiolated molecule is thiolated gelatin.
184. The compound of claim 173, wherein the thiolated molecule comprises two thiolated molecules, wherein the first thiolated molecule is the compound of claim 165 or 172, the second thiolated molecule is thiolated gelatin, and the compound having the formula XX is poly(ethylene glycol) diacrylate.
185. A polymer comprising at least one -ONHR group covalently attached to the polymer, wherein R is hydrogen, an alkyl group, or an aryl group.
186. The polymer of claim 185, wherein the polymer comprises a polyethylene glycol, polypropylene oxide, or polyvinyl alcohol.
187. The polymer of claim 185, wherein R is hydrogen.
188. The polymer of claim 185, wherein the polymer is a triblock polymer of poly(ethylene oxide)-poly(propylene oxide)-poly(ethylene oxide).
189. The polymer of claim 185, wherein the polymer has a molecular weight of from 1,000 Da to 100,000 Da.
190. The polymer of claim 185, wherein the polymer has a molecular weight of from 5,000 Da to 15,000 Da.
191. The polymer of claim 185, wherein the polymer is $\text{PEO}_{103}\text{-PPO}_{39}\text{-PEO}_{103}$, $\text{PEO}_{132}\text{-PPO}_{50}\text{-PEO}_{132}$, or $\text{PEO}_{100}\text{-PPO}_{65}\text{-PEO}_{100}$.
192. The polymer of claim 185, wherein the polymer has one -ONH_2 group attached to the polymer.
193. The polymer of claim 185, wherein the polymer has two -ONH_2 groups attached to the polymer.
194. The polymer of claim 185, wherein the polymer is $\text{PEO}_{103}\text{-PPO}_{39}\text{-PEO}_{103}$, $\text{PEO}_{132}\text{-PPO}_{50}\text{-PEO}_{132}$, or $\text{PEO}_{100}\text{-PPO}_{65}\text{-PEO}_{100}$, wherein the polymer has

one or two $-\text{ONH}_2$ groups covalently bonded to it.

195. A composition produced by the process comprising reacting a compound in any of claims 159-172 with a macromolecule.
196. The composition of claim 195, wherein the macromolecule comprises
5 chondroitin, chondroitin sulfate, dermatan, dermatan sulfate, heparin, heparan sulfate, alginic acid, or pectin.
197. The composition of claim 195, wherein the macromolecule is hyaluronan.
198. The composition of claim 195, wherein the compound is a triblock polymer of poly(ethylene oxide)-poly(propylene oxide)-poly(ethylene oxide)
10 comprising one or two $-\text{ONH}_2$ groups and the macromolecule is hyaluronan.
199. A pharmaceutical composition comprising a bioactive agent and the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198.
200. A pharmaceutical composition comprising a living cell and the compound or
15 composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198.
201. A method for improving wound healing in a subject in need of such improvement, comprising contacting the wound of the subject with the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82,
20 84-98, 117-127, or 150-198.
202. A method for delivering at least one bioactive agent to a patient in need of such delivery, comprising contacting at least one tissue capable of receiving the bioactive compound with the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198.
- 25 203. A method for delivering living cells to a patient in need of such delivery, comprising contacting at least one tissue capable of receiving the living cells with the compound or composition in any of claims 1-13, 24-44, 48-60, 62-

68, 71-82, 84-98, 117-127, or 150-198.

204. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 as a growth factor, an anti-inflammatory agent, an anti-cancer agent, an analgesic, an anti-infection agent, or an anti-cell attachment agent.
205. A composite comprising (1) a first compound comprising a first anti-adhesion compound covalently bonded to a first anti-adhesion support, wherein the first-anti adhesion support comprises any of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198, and (2) a first prohealing compound.
206. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to repair a tympanic membrane perforation.
207. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to prevent sinus osteum closure during or after FESS.
208. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to promote healing after FESS.
209. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to reduce scarring after FESS.
210. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to prevent adhesion after a surgical procedure.
211. The use of claim 210, wherein the surgical procedure comprises cardiosurgery and articular surgery, abdominal surgery, a surgical procedure performed in the urogenital region, a surgical procedure involving a tendon, laparoscopic surgery, pelvic surgery, oncological surgery, sinus and craniofacial surgery, ENT surgery, or a procedure involving spinal dura

repair.

212. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to prevent airway stenosis.
213. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 for vocal fold repair.
214. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to support the growth of primary cells or immortalized cells.
215. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to support the growth of tumor cells, fibroblasts, chondrocytes, stem cells, epithelial cells, neural cells, cells derived from the liver, endothelial cells, cardiac cells, muscle cells, or osteoblasts.
216. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 for bone or cartilage repair.
217. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to extend the viability of skin.
218. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 to promote scar-free wound healing after a surgical procedure.
219. An article coated with a compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198.
220. The article of claim 219, wherein the article is a suture, a clamp, a stent, a prosthesis, a catheter, a metal screw, a bone plate, a pin, or a bandage.
221. The use of the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198 as a 3-D cell culture.
222. The use of claim 221, wherein the cell culture is used to determine the

toxicity of a drug.

223. A cell culture produced by the compound or composition in any of claims 1-13, 24-44, 48-60, 62-68, 71-82, 84-98, 117-127, or 150-198.